

#2/IDS
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10/26/99

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PATENT

Docket No. D-349



6 IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
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9 Applicant - LUI, et al.) Information Disclosure
10) Statement
11)
12 Title - Gaussian Minimum Shift) Los Angeles, California
13 Keying (GMSK)) Date: 8/31/99
14 Precoding) Commissioner of Patents
15 Communication Method) and Trademarks
16) Washington, DC, 20231

17 ----- Dear Sir:
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19 INFORMATION DISCLOSURE STATEMENT
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21 Applicant hereby discloses information believed relevant to
22 the examination of the present application.
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24 Reference 1, P. Laurent, "Exact Approximation Construction of
25 Digital Phase Modulations by Superposition of Amplitude Modulated
26 Pulses (AMP)," IEEE Transactions on Communications, VOL. 34, NO. 2,
27 February, 1986.
28

1 Laurent teaches the expansion of the complex envelop of 2-ary
2 continuous phase modulation (CPM) signals as a sum of a sequence of
3 amplitude modulated pulses. This expansion has components that can
4 be isolated by respective match filters providing respective
5 partial representation of the signal for subsequent Viterbi
6 decoding. The present invention relies upon Laurent filtering to
7 isolate a principal component of the Laurent expansion in order to
8 achieve absolute phase demodulation, not suggested by Laurent.

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10 Reference 2, U. Megali and M. Morelli, "Decomposition of M-ary CPM
11 Signals into PAM Waveforms," IEEE Transactions on Communications,
12 VOL. COM-41, NO. 5, September 1995.

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14 Magalie teaches a generalized approach to higher order
15 alphabets of CPM signals, such as 4-ary and higher alphabets. The
16 present invention can also be extended to higher order alphabets to
17 the more generalize expansion.

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20 Reference 3, G. Kaleh, "Simple Coherent Receivers for Partial
21 Response Continuous Phase Modulation," IEEE Journal On Selected
22 Areas in Communications, VOL. 7, NO. 9, December 1989.

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24 Kaleh teaches that simple receivers structures for partial
25 response CPA signal can be developed from the Laurent signal
26 representation. Kaleh teaches the use of differential decoding in
27 combination with a simple Laurent expansion. The present invention
28 proceeds directly contrary to Kaleh, and implements data precoding

1 to achieve absolute phase demodulation in the Laurent filters to
2 thereby eliminate the need for differential decoding, while
3 offering improved performance.

4
5 Lui, GMSK Modulation, 6-18-97, Working Meeting and Advanced
6 Disclosure, The Aerospace Corporation.

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8 Lui is not considered prior art but only a limited distributed
9 advanced disclosure in connection with experimental preliminary
10 work by the inventors at the time of conception in support of
11 Government contracts. This information was disclosed to Government
12 contractors as experimental work under process at a technical
13 exchange meeting having a limited number of contractor attendees in
14 addition to Government employees as customers of the assignee.
15 This advanced publication was disclosed to a small number of
16 persons, less than twenty, from less than three contractor
17 companies. Though there was no confidentiality agreement in place,
18 these contractors typically keep these advanced disclosures
19 confidential as part of experimental development, dealing in good
20 faith, in a common effort to serve the interests of the U.S.
21 Government.

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23 This work mentions first conceptions of the 2-ary precoding
24 process. Only equation models were presented and no specific
25 precoding tables were disclosed. The alternative sign -1^k in the 2-
26 ary equation can be done at the transmitter or receiver without a
27 lost of generality. This -1^k sign attribute of the dual 2-ary
28 precoding methods was not disclosed at the working meeting. The

1 equations of $\{\alpha_n\}d_{n-1}d_n$ were not disclosed and is believed necessary
2 for realizing the specific 2-ary precoding table necessary for
3 implementing a reduction to practice. Lui is believed to be
4 nonenabling. No information at all was presented for the 4-ary
5 precoding method as it had not yet been conceived in furtherance of
6 the experimental development.

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8 Remarks

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10 The cited Laurent, Magalie, and Kaleh references do not teach
11 nor suggest the use of precoding to achieve absolute phase
12 demodulation to thereby eliminate the need for differential
13 decoding in a CPM GMSK modulation communication system.

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15 The limited advanced disclosure of Lui to Government
16 contractors in furtherance of Government business, as the
17 Government being assignee's primary customer, existed under an
18 implied condition of confidentiality. The advanced disclosure is
19 not considered a public disclosure. The advanced disclosure is not
20 considered an enabling disclosure of the 2-ary precoding table.
21 The advanced disclosure was in furtherance of experimental
22 development, ultimately leading to the preferred 4-ary precoding
23 table. The claimed 2-ary dual precoding scheme was not disclosed.
24 Even if one understood the 2-ary case, including the table and
25 could generate the 4-ary equations, the actual precoding specified
26 by the 4-ary table would not be obvious.

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1 Precoding algorithm is developed for specific values of the
2 modulation index. For the 2-ary case, there is only one preferred
3 value of the modulation index that is $1/2$, dictating the 2-ary
4 precoding table values. For the 4-ary case, the modulation index
5 can be either $1/4$ or $3/4$, and does not dictate the 4-ary precoding
6 table. As such, the modulation index precoding table is not
7 applicable to an arbitrary modulation index.

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9
10 For the 4-ary case, one skilled in the art must first search
11 for a suitable modulation index and then attempt to discover by
12 educated guesses what precoding table values might work. This
13 process is essentially a triple guessing game, including the number
14 of symbol used, multiplied the number of possible modulation
15 indices, multiplied by the number of possible precoder tables. The
16 number of possible modulation indices is infinite because any
17 arbitrary fraction between zero and one may be used, even though
18 the selection of common indices are typically $1/2$, $1/3$, $1/4$, $1/5$,
19 $1/6$, $1/8$, $1/9$, or $1/10$ with more than 100 possible values that have
20 been used or suggested in the art. The number of possible symbols
21 used could also be infinite and is specified in whole numbers
22 typically between 1 and 1024. The number of possible distinct 4-
23 ary tables using four values (± 1 and ± 3) is 4 to the power of 4 to
24 the power four times the number of symbols, 1000. Hence, the
25 triple guessing game offers a vast number of choices, and was found
26 by the inventors essentially through trial and error and educated
27 guesses. Through trial and error and educated guesses the
28 inventors have discovered a particular combination of the number of

1 symbols, the modulation indexes and a particular 4-ary table, that
2 functions to meet the objects of the invention.

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4 The prior art did not teach nor suggest data precoding to
5 achieve absolute phase demodulation in a CPM receiver. The
6 advanced disclosure was in the nature of experimental effort, and
7 is not considered a public disclosure, nor considered an enabling
8 disclosure. Even if found to be public, enabling and
9 nonexperimental, the advanced disclosure did not teach nor suggest
10 the flip flop sign attribute of the 2-ary case, nor the 4-ary
11 selected modulation indices and respective precoding tables.
12 Allowance of the claims is requested.

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14 Date: 8/31/99

Respectfully Submitted

15 *Derrick Michael Reid*
16 Derrick Michael Reid
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